PATENT ABSTRACTS OF JAPAN

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(54) PRODUCTION OF MASTER DISK FOR OPTICAL DISK

(57)Abstract:
PURPOSE: To obtain a process for producing a master disk for optical disks of a land/groove system formed with guide grooves having high-accuracy groove widths.
CONSTITUTION: This process comprises producing the master disk for optical disks of the land/groove system. The region 11 of the master disk 1 formed with a photosensitive filmwhich region corresponds to the data recording region of the optical diskis exposed and the region (monitor region) 12 different from the region 11 corresponding to the data recording region is so exposed that the grooves having the groove width of about ≤25% of the groove pitch are formed. The monitor is photo-irradiated and the intensity of the diffracted light is observed. This intensity is compared with the intensity of the diffracted light from the previously produced master disk model having the desired groove widths and the end point of development is determined.

CLAIMS

[Claim(s)]
[Claim 1]A process of being a manufacturing method of original recording for optical discs of the land / groove method which is about 50% of the flute width fang furrow pitches of a guide railand forming a film on a substrateWhile exposing a field corresponding to data recording regions of an optical disc of a film by optical exposureA process of carrying out an optical exposure and exposing a part of different field from a

field corresponding to these data recording regions so that a flute width / groove pitch ratio may differ from the flute width / groove pitch ratio in a field corresponding to these data recording regionsA manufacturing method of original recording for optical discs of the above-mentioned land / groove method which adjusts developing time by carrying out an optical exposure in a part of different described area from a field corresponding to the above-mentioned data recording regionsand observing intensity of the diffracted light between the above-mentioned developing processes including a process of developing a substrate with which the above-mentioned film was formed.

[Claim 2]A manufacturing method of original recording for optical discs of claim 1 adjusting developing time by measuring diffracted-light intensity from a described area which measures diffracted-light intensity from an original recording model for optical discs which has a flute width of a request produced beforehandand is different from a field corresponding to this measured value and the above-mentioned data recording regions.

[Claim 3]A manufacturing method of original recording for optical discs of claim 1 or 2 exposed by carrying out an optical exposure so that a groove pitch may become a different interval from a groove pitch in data recording regionswhen exposing a part of different field from a field corresponding to the above-mentioned data recording regions.

[Claim 4]A manufacturing method of original recording for optical discs of any 1 paragraph of claims 1-3 exposing a part of different described area from a field corresponding to the above-mentioned data recording regions so that a slot which has less than about 50% of flute width of a groove pitch may be formed.

[Claim 5]A manufacturing method of original recording for optical discs of any 1 paragraph of claims 1-4 exposing a part of different described area from a field corresponding to the above-mentioned data recording regions so that a slot which has about 10 to 45% of flute width of a groove pitch may be formed.

[Claim 6]A developing method characterized by comprising the following at the time of manufacturing original recording for optical discs of a land / groove method with photolithography technology.

A part of field which carries out an optical exposureexposes a field corresponding to data recording regions of an optical disc beforehand so that a guide rail which has about 50% of flute width of a groove pitch may be formedand is different from a field corresponding to these data recording regions. A process which carries out an optical exposure and is exposed so that a flute width / groove pitch ratio may differ from

the flute width / groove pitch ratio in a field corresponding to these data recording regions.
A film exposed [above-mentioned].

[Claim 7]A developing method of claim 6 exposed by carrying out an optical exposure so that a groove pitch may become a different interval from a groove pitch in data recording regionswhen exposing a part of different field from a field corresponding to the above-mentioned data recording regions.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the developing method used for the manufacturing method of the original recording for optical discs of a land / groove method and it whichmore particularlyhave a highly precise flute width about the manufacturing method of the original recording for optical discs used for manufacture of the optical disk substrate of a land / groove method.
[0002]
[Description of the Prior Art]In recent yearsdevelopment of optical discssuch as a compact disk (CD) and a magneto-optical discis performed briskly. The polycarbonate board etc. which were pre formatted by injection molding are used for the substrate for optical discs. In order to manufacture this substratethe original recording for optical discs is usually produced according to the following processes. Heat treatment is performed and a photoresist film is formedafter washing the glass substrate which gave optical polish firstdrying and applying photoresist material uniformly on a substrates face. Nextthe portion which is irradiated with a laser beam on the surface of a photoresist film and in which a guide rail and a pit are formed is exposed. The exposed photoresist film is developed with an alkaline developing solutionand a guide rail and pit shapes are acquired. FinallyUV irradiation and high temperature heat treatment are performeda regist layer is stiffened firmlyit cools radiationallyand a master optical disk is obtained.
[0003]In the above-mentioned developing processa developing solution is eluted in an exposed part and usually forms the guide rail portion of an optical disc. Howeversince the laser beam used for exposure has the spatial intensity distribution according to a Gaussian distribution

curvethe boundary of an exposed part and an unexposed portion is not necessarily clearand the area of the slot where it will be eluted if developing time becomes long increases gradually. Thereforein order to have obtained the guide rail of the exact flute widththe time which contacts resist to a developing solutioni.e.developing timehad to be adjusted. In an optical discsince especially the error of a flute width affects the C/N ratio and tracking of record and a regenerative signalit needs to form a slot in high degree of accuracy.

[0004]Developing the original recording in which resist was formedin order to adjust this flute width conventionallywhen the field in which a guide rail is formed was irradiated with a laser beamthe diffracted-light intensity from there was monitored and that intensity reached predetermined intensitydevelopment was terminated. That isin order that the substrate with which the guide rail was formed periodically might act as a diffraction gratingit irradiated with light from the substrate sideand was adjusting change of the flute width and the channel depth from diffracted-light intensity.

[0005]

[Problem(s) to be Solved by the Invention]By the wayin the field of the magneto-optical discin order to attain high density recordingfalling a cross talka recording track field is constituted from a land part and a slotand what is called the land / a groove method that made width of the slot about 50% of groove pitches (track pitch) are devised. When manufacturing the original recording for the optical discs of this land / groove methodin the above-mentioned developing processit becomes about 50% of the desired value fang furrow pitches of a flute width. Howeverwhen slit width becomes about 50% of a grating constant in a diffraction gratingit requires that change of the diffracted-light intensity to slit width becomes the smallest as it is theoretically sudden. For this reasonsince diffracted-light intensity change of as opposed to change of the flute width from the original recording for optical discs of a land / groove method with the method of monitoring the conventional diffracted-light intensity and adjusting developing time is too smallprecise adjustment of a flute width is difficult.

[0006]The purpose of this invention is to provide the manufacturing method of the original recording for optical discs of the land / groove method with which the guide rail which has a highly precise flute width was formed.

[0007]When another purpose of this invention manufactures the original recording for optical discs of a land / groove method with photolithography technologythere is in providing the developing method

which can control a flute width by developing time precisely.
[0008]
[Means for Solving the Problem]A process of being a manufacturing method of original recording for optical discs of the land / groove method which is about 50% of the flute width fang furrow pitches of a guide railand forming a film on a substrate if the 1st mode of this invention is followedWhile carrying out an optical exposure and exposing a field corresponding to data recording regions of an optical disc of a filmA process of carrying out an optical exposure and exposing a part of different field from a field corresponding to these data recording regions so that a flute width / groove pitch ratio may differ from the flute width / groove pitch ratio in a field corresponding to these data recording regionsA substrate with which the above-mentioned film was formed including a process to develop between the above-mentioned developing processesA manufacturing method of original recording for optical discs of the above-mentioned land / groove method which adjusts developing time is provided by carrying out an optical exposure in a part of different described area from a field corresponding to the above-mentioned data recording regionsand observing intensity of the diffracted light.
[0009]In a manufacturing method of original recording for optical discs of the above-mentioned land / groove methodIt is preferred to adjust developing time by measuring intensity of the diffracted light from a described area which measures diffracted-light intensity from an original recording model for optical discs which has a flute width of a request produced beforehandand is different from a field corresponding to this measured value and the above-mentioned data recording regions. A ratio which is different from the flute width / groove pitch ratio of a field corresponding to data recording regions in a flute width / groove pitch ratio in a part of different field from a field corresponding to data recording regionsThat isas for about 50% of flute width fang furrow pitchesit is preferred to change a groove pitch into a different interval from a groove pitch in data recording regions as a method of carrying out an optical exposureand to carry out an optical exposure so that it may become a different rate.
[0010]In a manufacturing method of original recording for optical discs of the above-mentioned land / groove methodit is preferred to expose a part of different field from a field corresponding to the above-mentioned data recording regions so that two or more slots which have less than about 50% of flute width of a groove pitch may be formed. It is preferred to expose so that two or more slots which have about 10 to

45% of flute width of a groove pitch may be formed much more preferably.
[0011]If the 2nd mode of this invention is followedit will be a developing method at the time of manufacturing original recording for optical discs of a land / groove method with photolithography technologyBeforehandA field corresponding to data recording regions of an optical disc so that a guide rail which has about 50% of flute width of a groove pitch may be formed. A process of carrying out an optical exposure and exposing a part of field which is exposed by optical exposure and is different from a field corresponding to data recording regions so that a flute width / groove pitch ratio may differ from the flute width / groove pitch ratio in a field corresponding to data recording regionsA substrate which has the film exposed [above-mentioned] including a process to develop between the above-mentioned developing processesWhen in agreement with diffracted-light intensity from an original recording model for optical discs which has a flute width of a request which irradiated a part of different field from a field corresponding to the above-mentioned data recording regions with a laser beamand observed intensity of the diffracted lightand observed diffracted-light intensity produced beforehandthe above-mentioned developing method which ends development operation is provided. A ratio which is different from the flute width / groove pitch ratio in a field corresponding to data recording regions in a flute width / groove pitch ratio in a part of different field from a field corresponding to data recording regionsThat isas for about 50% of flute width fang furrow pitchesit is preferred to change a groove pitch into a different interval from a groove pitch in data recording regions as a method of carrying out an optical exposureand to carry out an optical exposure so that it may become a different rate.
[0012]In this specificationan optical disc is a concept containing all the optical recording media of the added type of a postscriptand an erasable type only for [such as a compact disk (CD)a magneto-optical discand a phase-change optical disk] playback.
[0013]
[Function]According to the manufacturing method of the original recording for optical discs of the land / groove method of this inventionthe exposure region for the monitor for judging a development terminal point that desired guiding groove width is obtained by a development is established in a different field from the field corresponding to the data recording regions of original recording. A laser beam is irradiated so that the slot which has about 25% of flute widthfor example may be formed in the exposure region for this monitor

after development except about 50% of groove pitches. In the magneto-optical disc of a land groove methodsince it is about 50% of the desired value fang furrow pitches of a flute widthwhen the original recording for magneto-optical discs is regarded as a diffraction gratingchange of the flute width which is slit width near the desired valuei.e.change of the diffracted-light intensity to developing timeis very small (refer to drawing 5). Soin this inventionchange of the diffracted-light intensity to change (developing time) of a flute width formed the large monitor area according to the exposure step (refer to drawing 4).

[0014]According to the developing method at the time of manufacturing the original recording for optical discs of the land / groove method of this invention with photolithography technology. A development terminal point can be judged easily and correctly by measuring the diffracted-light intensity from the model original recording which has a flute width of the request produced beforehandand the diffracted-light intensity from a monitor area.

[0015]

[Example]Hereafterthe example of this invention is describedreferring to drawings. In this examplea numerical aperture (land part: slot ratio) manufactures the original recording for magneto-optical discs of 50% of a land / groove method. Positive type photoresist (AZ1400 by Shipley) was applied by a thickness of about 140 nm on glass original recording (200 mm in diameterand 10 mm in thickness). Thenthe remains solvent was evaporated at the temperature of 80 ** in the **-KU furnaceand the photoresist film was formed. The laser writing device provided with the acoustooptic modulator and the acoustooptic deflector was equipped with this original recordingand it irradiated with the laser beam modulated and deflected based on the input signalrotating original recordingand the portion which forms a light spot guide rail and a header signal pit was made to expose. Herethe line width of the light spot guide rail was 0.75 micrometerand the track pitch made 1.5 micrometers the desired value (50% of numerical aperture). As shown in drawing 2it exposed so that about 1000 slots whose line width is 0.75 micrometer and whose track pitches are 3.0 micrometers might be formed in the field (monitor area) 12 of the outside of the field 11 used as the data recording regions of the optical disc of the original recording 1 (25% of numerical aperture). That isit exposed with the cycle that a slot is formed to the field in which said light spot guide rail is formed as for every other track.

[0016]The developer 10 with a diffracted-light sensor shown in drawing 3 was equipped with the original recording exposed as mentioned aboveand

the development was performed. In this developer 10the surface of the original recording 1 is filled with the shower of the alkali developing solution 8 from the nozzle 7 with which it was equipped above original recording by the flow of 50ml/secondrotating the original recording 1 with the revolving speed of 600 revolutions per minute with the spindle 5. While the sensor 4 installed right above the monitor area 12 detects the zero order light which irradiated with the laser beam by the laser light source 3 (lambda= 680 nm) from the lower part of the monitor area 12 of original recordingand penetrated the monitor area 12 at this timeThe primary diffracted light was detected by sensor 4' installed in the slanting upper part of the monitor area 12.

[0017]Change of the diffracted-light intensity to developing timei.e. the time which poured out the alkali developing solutionis shown in drawing 4. A desired value is the diffracted-light intensity from the model of the original recording which has the flute width and channel depth which are made into the target produced beforehand among a figure. This model original recording is produced with the same material and size as this example.

The slot of 50% of a numerical aperture and 25% of slot are formed to another field on original recording.

Thereforewhen the same diffracted-light intensity as the diffracted-light intensity from a model is obtainedthe guide rail of the same flute width as model original recording is obtained by ending a development. It turns out that diffracted-light intensity has rate of change sufficient near the desired value of the diffracted light from drawing 3 to developing timeand developing timei.e.a flute widthcan be adjusted with high precision with diffracted-light intensity. The result of having irradiated the field corresponding to the data recording regions of an optical disc instead of the monitor area 12 with the laser beamand having measured diffracted-light intensity change is shown in drawing 5 at the time of development. When the original recording surface is seen as a diffraction gratingsince it is designed so that a numerical aperture may be 50%in diffracted-light intensity changechange becomes small near a desired valueand it turns out that the precise control to a target flute width is difficult in data recording regions.

[0018]After having irradiated with ultraviolet rays all over original recording after the development was completedand making unreacted photoresist react120 ** was describedit heated in - KU furnace for 1 hourand resist was stiffened firmly. The expansion perspective view of the portion corresponding to the data recording regions of the obtained original recording is shown in drawing 1. The original recording which

has flute width [of 0.75 micrometer] and track pitch 1.5micrometer considered as a request was obtained.

[0019]Although the monitor area as for which every other track formed the guide rail was provided in this examplethis invention is not limited to this and can also make the field which does not form a guide railfor example all over 1 track. A numerical aperture is also a numerical aperture not only exceeding 25% but less than 50% or 50%and the diffraction intensity change to change of a flute width can choose the numerical aperture which becomes comparatively large. The monitor area 12 may be produced to the field 13 inside data recording regionsas shown not only in the field of the outside of the data recording regions of a magneto-optical disc but in drawing 2. In this casethe material or structure of the spindle 5 can be changed so that irradiation light can penetrate the spindle 5. Although the flute width to a track pitch was adjusted by changing a track pitch (groove pitch) in the above-mentioned exampleit can adjust also by changing a flute width.

[0020]

[Effect of the Invention]According to the manufacturing method of the original recording for optical discs of the land / groove method of this inventionthe original recording for optical discs of the land / groove method with which the guide rail which has a highly precise flute width was formed can be obtained. According to the developing method at the time of manufacturing the original recording for optical discs of the land / groove method of this invention with photolithography technologyguiding groove width is easily and precisely controllable using developing time.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is an expansion perspective view of the portion corresponding to the data recording regions of the original recording for magneto-optical discs obtained by the example.

[Drawing 2]It is a top view of the original recording for magneto-optical discs obtained by the example.

[Drawing 3]It is a key map showing the situation of a development using the developer of the original recording for optical discs.

[Drawing 4]In the developing process of an exampleit is a graph which shows the relation between the diffracted-light intensity from a monitor areaand developing time.

[Drawing 5]In the developing process of an exampleit is a graph which shows the relation between the diffracted-light intensity from the field corresponding to data recording regionsand developing time.

[Description of Notations]

1 Glass substrate
2 Photoresist
3 Laser light source
4 Sensor
5 Spindle
7 Nozzle
8 Alkaline developing solution
10 Developer
11 Data recording regions
12 Monitor area
13 Monitor area